State & Private Forestry
FOREST HEALTH PROTECTION
Northern California Shared Service Area

Date: March 21, 2022

Topic: Conifer mortality on the Middletown Rancheria (FHP Report NC22-001)

Issue*:* *Mortality among the ponderosa pines and Douglas-firs was observed and reported by Curtis Ewing, Cal-Fire Forest Health Specialist, in April and December 2021. Infestation by native bark beetles (Scolytinae) and flatheaded borers (Buprestidae), facilitated by drought, was determined to be the most likely cause of the observed mortality. Sampling of the root collar did not reveal any evidence of root disease. Removal of affected trees was recommended at that time to reduce reproduction of the beetles. Forest Health Protection was called in February of 2022 as additional mortality continued across the Tribal trust land and onto the neighboring Tribal fee land and a project to reduce fuel loading, reduce risk of further tree mortality, and restore the declining ecosystem (fig.9-12 at end).*

Background:

Progressive changes in forest structure and composition have been well documented across yellow pine forests in California since the early 1900s. In lower elevation sites such as the Middletown Rancheria, this includes a transition from low-density, open park-like forests comprised of large-diameter (>24 inch dbh) ponderosa pine to dense, second-growth forests composed of smaller-diameter trees with increased densities of Douglas-fir. These dense conditions resulted from extensive forest disturbance in the early 1900s, including timber harvesting that fueled local economies and wildfires followed by periods of forest regrowth and densification that were promoted by fire exclusion.

In California, droughts are a regular occurrence, but the 2012-2015 drought was characterized by large precipitation deficits and abnormally high temperatures. Drought has persisted as a major stressor on forests in northwestern California from 2019 to present. The year 2021 is the 3rd driest in more than 100 years of precipitation record. 2020 was the 9th driest year in the precipitation record. January and February 2022 were the driest on record for those two months for much of California. Warmer temperatures from climate change are worsening droughts. In 2021 trees throughout California were under high to extreme levels of water stress. Water stress within an individual tree increases from the base of the tree to the top of the crown. Water stress affects trees directly by slowing or arresting growth and causing injury or death; or indirectly, by increasing their susceptibility to wildfire, insects, and disease.

The current and ongoing drought has resulted in progressive and severe canopy water stress and substantial mortality of the dominant and co-dominant ponderosa pine trees, much of which can be attributed to western pine beetle (*Dendroctonus brevicomis*). The midstory Douglas-fir were subjected to increased exposure as pines were removed increasing evapotranspiration leading to mortality due primarily to Douglas-fir engraver beetles (*Scolytus unispinosus*) and flatheaded fir borer (*Phaenops drummondi*).

The Tribe has a project proposal that would reduce fuel loading caused by the tree mortality, reduce water stress to remaining trees, and restore valuable forest resources. The project area has been divided into sections (fig.1) in which hazardous dead trees will be removed. Dead trees have been identified and marked for removal. A total count of dead trees has been accounted for in each section. The proposed project consists of removing dead, dying, and diseased hazardous trees, which will reduce the risk of wildfires. Opening tree stands will create less stress on trees. The removed dead trees and vegetation will be processed in BioChar Woodbox for use soil additive preproposal. There is a NEPA approval and Timber Harvest permit from BIA secured and reserved for the purpose of this project. The project area has been divided into sections in which hazardous dead trees will be removed. The benefits of this project will improve the forest's health and create fire safety within the Rancheria and surrounding communities. Thinning will allow for better land management as well as the potential development of cultural development projects.

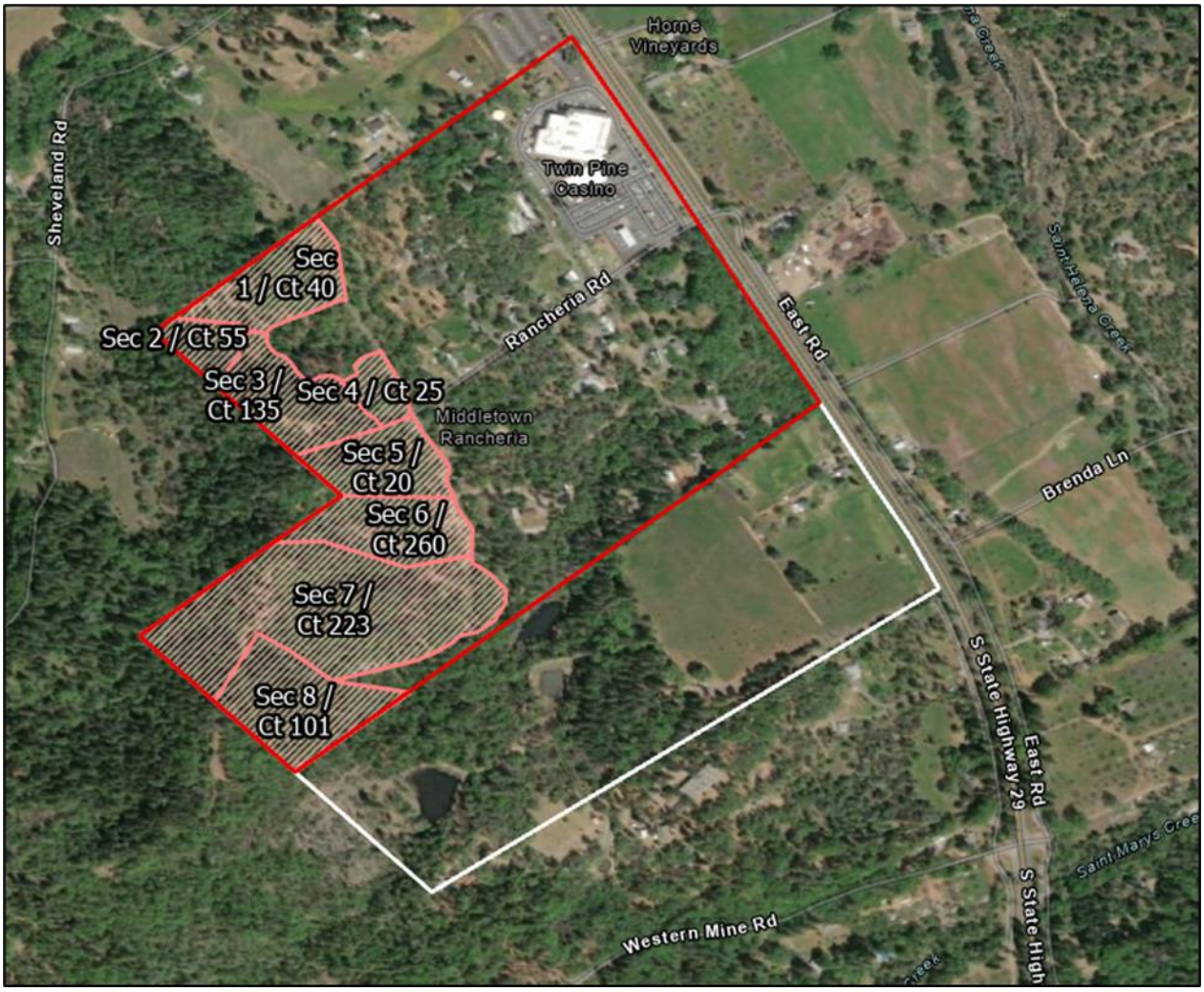

Figure 1. Map of project area sectioned with number of dead trees at time of project proposal.

The Tribe requested a report to provide advice on how to minimize the spread of bark beetles into trees not already infested and recommendations on management efforts that may help the forest ecosystem recover from drought and pest impacts and make the forest ecosystem more resilient to these and other climate change pressures.

Observations:

- The first trees to die appeared to be the ponderosa pine.
    - Ponderosa pines were heavily infested with western pine beetle (*Dendroctonus brevicomis*) which are the primary native pest of this species (fig.2). Extensive gallery damage was observed under the bark (fig. 3) as well as blue stain fungi damage to sapwood in cross section (fig. 4).
        - Western pine beetle usually breeds in, and kills scattered, overmature or highly stressed trees. Trees that are diseased or weakened by drought, fire, lightning, or mechanical injuries are more susceptible to attack. Most outbreaks of western pine beetle are incited by drought and supported by landscapes of high-density host trees.
        - The beetle may cause mortality of 60 to 90 percent of host trees in some landscapes. The most recent notable outbreak occurred in the central and southern Sierra Nevada Range in California from 2014 to 2017, causing mortality of millions of ponderosa pines.
        - Attacks are most easily identified by the presence of pitch tubes, masses of resin that often contain boring dust. Pitch tubes range from creamy white to brownish red in color and are approximately ¼ to ½ inch in diameter (fig. 5). Occasionally, only boring dust will be present on the outer bark. This is most commonly observed during a severe drought when a pine's ability to produce resin is impaired. Initial attacks typically occur midway up the tree bole with later attacks occurring above and below.
        - The beetle requires thick bark to complete its life cycle, so it rarely attacks trees <6 inches DBH, even during severe outbreaks. It has 2 to 2 ½ generations per year in northern California.

Figure 2. Western pine beetle adult.

Figure 3. Western pine beetle adult gallery under the bark of ponderosa pine

Figure 4. Blue stain fungi associated with bark beetles.

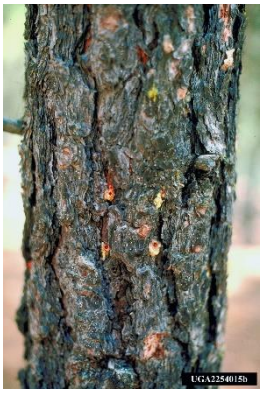

Figure 5. Pitch tubes on tree stem associated with bark beetle attack.

  - Many of the affected pines were felled following the report from Cal-Fire.
- Although some of the Douglas-fir appeared to have died simultaneously with the pines, many appeared to be dying after the pines died and were removed.
  - Douglas-fir showed evidence of attack by Douglas-fir engraver beetles (*Scolytus unispinosus*) (fig. 6) which are the most likely primary pest species affecting them. Symptoms of attack by this species is top kill, with all branches at a particular node dying at once, and browning proceeding downward over time.
    - Douglas-fir engraver beetles have one to two generations per year. Beetles usually emerge and attack in the spring. The larvae feed under the bark in the phloem layer (fig. 7).
    - These beetles cause mortality in smaller trees and top-kill or branch-kill in larger trees, with occasional mortality in larger trees.
    - Douglas -fir engraver beetles prefer to attack trees that are injured by fire scorch, defoliation, blowdown, or root disease.
    - Stand conditions and weather strongly influence beetle populations. Under drought conditions, they have been known to attack and kill Douglas-fir as large as 12 inches (30 cm) in diameter.
  - There was also evidence of flatheaded fir borer (*Phaenops drummondi*) (fig. 8).
    - Although not a bark beetle, this insect acts like a bark beetle in that most of its life cycle is spent as larvae in the phloem layer and is able to kill green, apparently healthy Douglas-fir, especially at lower elevations on warm, dry sites.
    - Tree mortality is continuous, slow-paced, and scattered, but picks up during/after drought years.
    - Following the 2013-15 “hot drought,” the flatheaded fir borer (FFB) killed tens of thousands of Douglas-fir throughout the region

- Douglas-fir being sheltered by a ponderosa pine overstory that died due to western pine beetle infestation were subjected to immediate direct sunlight and increased evapotranspiration. This has been known to cause increased water stress which may have led to the quick mortality seen in the affected trees.

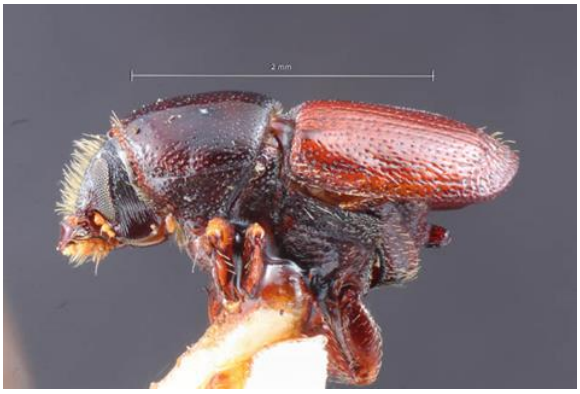

Figure 6. Douglas-fir engraver beetle adult.

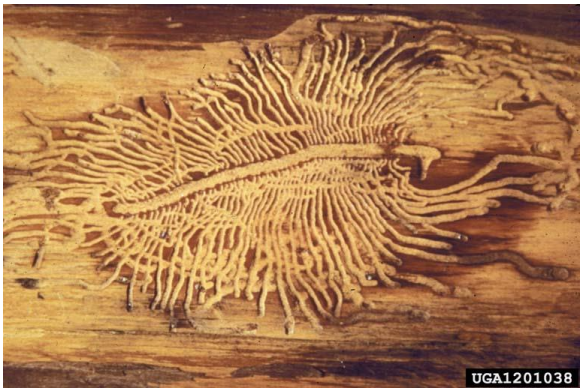

Figure 7. Douglas-fir engraver beetle adult and larval galleries under the bark of Douglas-fir.

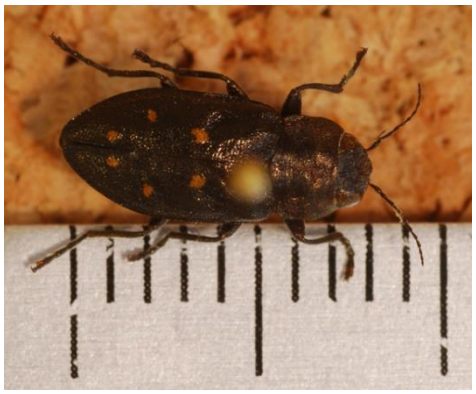

Figure 8. Flatheaded fir borer adult.

Recommendations:

Drought conditions continue to stress trees in the forests of northern California. Stressed trees are more susceptible to native insect and disease pests. Thinning may help with the pine systems but is not studied well in oak systems. Oak is considered more drought tolerant than pine and is not showing evidence of drought stress at this time. It is recommended that any living pines be surveyed for bark beetle attack and removed. Attacks are most easily identified by the presence of pitch tubes, masses of resin that often contain boring dust.

There are two strategies for managing western pine beetle: direct control and indirect control. Direct control is s designed to treat current infestations through manipulating beetle populations with sanitation harvests, chemical applications (i.e., insecticides and pheromones), or both. Indirect control involves preventive measures designed to decrease the probability and severity of future western pine beetle infestations by reducing tree density, increasing tree vigor, and encouraging tree species and structural diversity. Insecticides may be a viable option for protecting uncolonized individual high value trees. These include contact insecticides applied directly to the tree bole (bole sprays) or systemic insecticides injected directly into the tree (bole injections) near the root collar. Several formulations are available and highly effective (90 to 100 percent) when properly applied. Most provide two field seasons of protection with a single application. If conditions contributing to outbreaks do not change, preventative insecticide applications will be required until western pine beetle populations collapse.

Western pine beetle impacts can be mitigated through short- and long-term silvicultural treatments. Stands with appropriate spacing among host trees provide some resistance to infestation. Encouraging tree species and size class diversity also increases resistance. Thinning practices that reduce average stand density to <90 ft2 of basal area per acre that also produce multistoried and multi-species stands are considered the most effective indirect control treatments.

Removal of trees that pose a threat to the public is advised for this situation as well as continued monitoring as the drought persists.

Because Douglas-fir pole beetles and engraver beetles, and flatheaded fir borers, are considered secondary insects associated with trees under stress, enhancing tree/stand quality will help to prevent attacks. The best management approach is to promote stand vigor by thinning and promptly removing windthrown trees or trees damaged by other stand disturbances. However, drier Douglas-fir sites on edge of transition into forest types such as ponderosa pine/black oak or edges of Oregon white oak or black oak stands may become inhospitable for Douglas-fir. These oak/pine habitats would be best suited to treating for the remaining healthy pine and oak trees and letting the Douglas-fir go.

- Sanitation and thinning of the ponderosa pine and encouraging tree species and size class diversity increases resistance.
- Thinning practices that reduce average stand density to <90 ft2 of basal area per acre that also produce multistoried stands are considered the most effective indirect control treatments.
- Slash should be removed promptly to reduce risk of further beetle spread.
- For Douglas-fir, thinning is often recommended to increase resilience of remaining trees with more intensive thinning on poor sites. However, thinning may not be enough on really poor sites (oak-pine habitats). In this case sanitation is recommended, the targeted removal of stressed trees (weak crowns, fire/mechanical/etc. damage). There is a small group of Douglas-fir on a north-facing slope next to the water tank that may be suited for the site. Monitoring for mortality would be recommended here.

Restoring forests impacted by western pine beetle and flatheaded fir borer requires a flexible approach with management decisions influenced by landowner objectives, severity of tree losses, and the overall condition and location of the affected area. In most forests, little or no restoration may be required. However, in the wildland urban interface removal of hazard trees may be important to protect human lives and critical infrastructure. Fuel treatments, such as prescribed fire, chipping, mastication, and thinning of trees, may be necessary. Planting of ponderosa pines may be necessary in areas of heavy tree mortality that lack adequate seed sources to rely on natural regeneration. Restoration provides an opportunity to create a more heterogeneous landscape increasing overall resistance to western pine beetle outbreaks and other disturbances.

To assist Michael Shaver and the Tribe with this endeavor, I supplied him with several reference books that explain the biology and management of forest insects and diseases. As always, I'm available to provide additional information and support.

If you have any questions regarding this report, please contact me at 530-226-2437.

/s/ Cynthia Snyder

CC: Mike Shaver (Middletown Rancheria), Kim Cole (Middletown Rancheria), Ashley Hawkins (USFS–FHP), Chris Fischer (USFS – FHP), Curtis Ewing (Cal-Fire)

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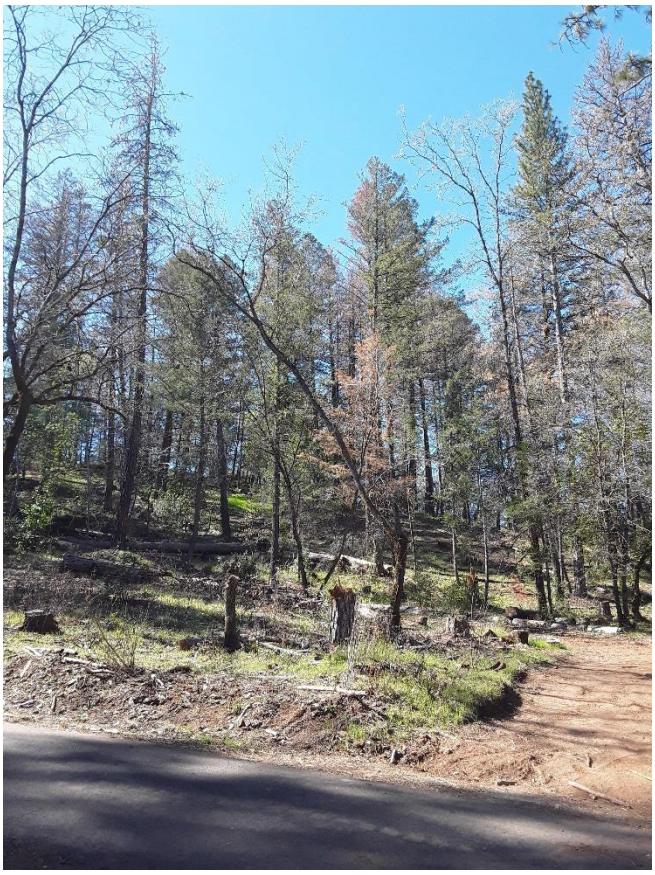

Figure 9. Ponderosa pine mortality caused by western pine beetle from the road going to the water tank.

Figure 10. Ponderosa pine mortality and Douglas-fir mortality on site.

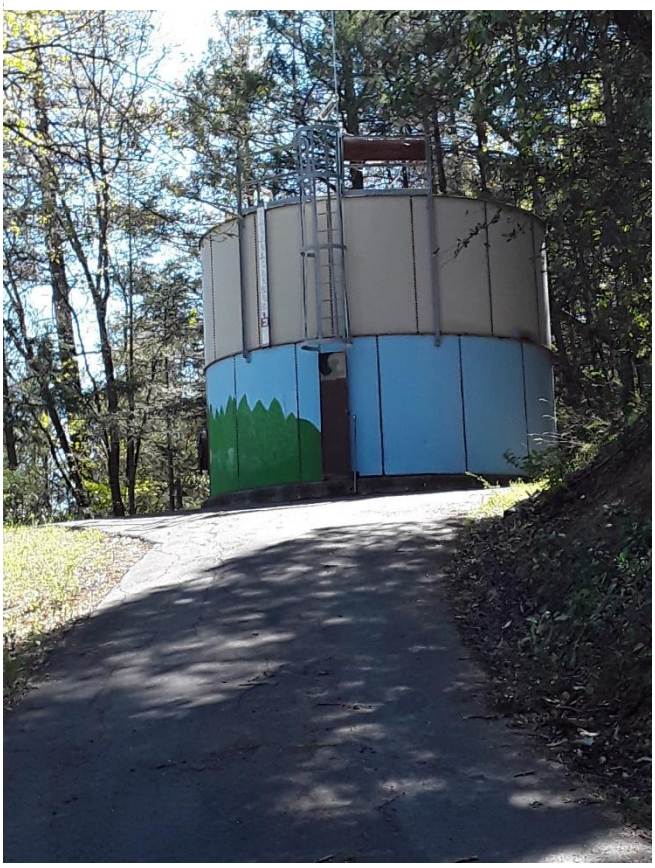

Figure 11. Rancheria water tank and remaining green Douglas-fir. North facing slope with adequate water for keeping Douglas-fir.